This article has been accepted for publication in BJSM following peer review.
The definitive copyedited, typeset version is available online at 10.1136/bjsports

Infographic. Systematic video analysis of ACL injuries in professional male football (soccer): injury mechanisms, situational patterns and biomechanics study on 134 consecutive cases

Francesco Della Villa[1], Matthew Buckthorpe[1,2], Alberto Grassi[3], Alberto Nabiuzzi[1], Filippo Tosarelli[1], Stefano Zaffagnini[3], Adam Virgile[4], Stefano Della Villa[1]

Affiliations:

1 Education and Research Department, Isokinetic Medical Group, FIFA Medical Centre of Excellence, Bologna, Italy

2 Faculty of Sport, Health and Applied Science, St Mary's University, London, UK

3 IIa Clinica Ortopedica e Traumatologica, Istituto Ortopedico Rizzoli, Bologna, Italy

4 College of Nursing and Health Sciences, University of Vermont, Vermont, USA

Corresponding author:

Dr Francesco Della Villa MD

Education and Research Department, Isokinetic Medical Group, FIFA Medical Centre of Excellence

Email: f.dellavilla@isokinetic.com

Telephone: 0039 0512986800

Word count – 399

Anterior cruciate ligament (ACL) injury is a severe and concerning health issue for the professional football player causing long layoff time.[1] Each team of 25 players can expect one ACL injury every two years.[2] Despite improved knowledge on ACL injuries and injury prevention, their rate in professional football is not declining.[1] Video-analysis can provide information on injury mechanisms, situational patterns and kinematics during actual injuries. This information can aid effective design of injury risk reduction programmes. There is a need for large studies using systematic evaluation of ACL injuries to provide conclusive evidence on ACL injury mechanisms in football.

Our paper[3] identified 148 ACL injuries across 10 seasons of professional Italian football. 134 (90%) injury videos were analysed for mechanism (injury causation referring to the player-to-player interaction that led to the injury) and situational pattern (situation leading to ACL injuries), whilst biomechanical analysis (kinematics) was possible in 107 cases. Three independent reviewers evaluated each video. Month, timing within the match and pitch location at the time of injury was also reported.

We found most injuries involved single leg loading of the injured limb. 88% of ACL injuries occurred without direct knee contact. 59 (44%) injuries were non-contact, 59 (44%) indirect contact (e.g. to the shoulder), and 16 (12%) were direct contact injuries (to the injured knee). We identified four key situational patterns for indirect and non-contact injuries, three previously described[4] (although with different prevalence): 1) pressing/tackling (n=55, 47%), 2) regaining balance after kicking (n=19, 16%) and 3) landing from a jump (n=8, 7%) and a new situational pattern, “tackled” (n=24, 20%). Indirect contact mostly occurred prior to the injury, predominantly to the upper body. This mechanical perturbation, often coupled with a distraction immediately prior to injury, played an important role in the causation of tackled injuries in our cohort, and has been shown to be important in other sports.[5] Our data support the existing literature showing ACL injuries occur generally with shallow knee flexion and dynamic knee valgus loading.[4, 6] Knee valgus loading (n=83, 81%) was the dominant injury pattern across all situational patterns. 62% of injuries occurred in the first half of matches ($p<0.01$), which suggests accumulating fatigue throughout the match is not a key risk factor for injury. This information provides a more conclusive explanation of the mechanisms, situational patterns and biomechanics of ACL injuries in football and used effectively may support more optimised injury prevention practices.

Competing interests:

There are no competing interest for any author.

Contributorship:

MB and FDV wrote the manuscript. AV produced the infographic with intellectual contribution from all authors.

Acknowledgements:

None

Funding info:

There was no external funding for this study.

REFERENCES

1) Waldén M, Ha gglund M, Magnusson H, et al. ACL injuries in men's professional football: a 15-year prospective study on time trends and return-to-play rates reveals only 65% of players still play at the top level 3 years after ACL rupture. *Br J Sports Med* 2016;50(12):744-50.
2) Grassi A, Macchiarola L, Filippini M, et al. Epidemiology of anterior cruciate ligament (ACL) injury in Italian first division football players. *Sport Health* 2020; 12(3):279-88.
3) Della Villa F, Buckthorpe M, Grassi A, et al. Systematic video analysis of ACL injuries in professional male football (soccer): injury mechanisms, situational patterns and biomechanics study on 134 consecutive cases. *Br J Sports Med* 2020. Published Online First: 19 June 2020. doi: 10.1136/bjsports-2019-101247.
4) Waldén M, Krosshaug T, Bjørneboe J, et al. Three distinct mechanisms predominate in non-contact anterior cruciate ligament injuries in male professional football players: a systematic video analysis of 39 cases. *Br J Sports Med* 2015; 49(22):1452-60.
5) Johnston JT, Mandelbaum BR, Schub D, et al. Video analysis of anterior cruciate ligament tears in professional American football athletes. *Am J Sports Med* 2018; 46(4):862-8.
6) Koga H, Nakamae A, Shima Y, et al. Mechanisms for noncontact anterior cruciate ligament injuries: knee joint kinematics in 10 injury situations from female team handball and basketball. *Am J Sports Med* 2010; 38:2218–25.